

What is claimed is:

1. A functional organic thin film comprising a network structure moiety including silicon atoms and oxygen atoms and formed on a base; and a π -electron conjugated system molecule bonded to the network structure moiety via an insulating molecule.
2. The functional organic thin film as set forth in claim 1, wherein the network structure moiety has a Si-O-Si bond.
3. The functional organic thin film as set forth in claim 1 or 2, wherein the insulating molecule is a linear alkyl molecule having 12 to 30 carbon atoms.
4. The functional organic thin film as set forth in any one of claims 1 to 3, wherein the π -electron conjugated system molecule include 2 to 30 linearly bonded units, each of the units constituting the π -electron conjugated system.
5. The functional organic thin film as set forth in any one of claim 1 to 4, wherein each of the units constituting the π -electron conjugated system of the π -electron conjugated system molecule is one or more compounds selected from the group consisting of an aromatic hydrocarbon, a condensed polycyclic hydrocarbon, a monocyclic heterocyclic, a condensed heterocyclic, an alkene, an alkadiene and an alkatriene.
6. The functional organic thin film as set forth in claim 4 or 5, wherein each of the units constituting the π -electron conjugated system of the π -electron conjugated system molecule has an acene skeleton with 2 to 12 benzene rings.
7. The functional organic thin film as set forth in claim 4 or 5, wherein each of the units constituting the π -electron conjugated system of the π -electron conjugated system molecule is a π -electron conjugated system organic residue including at least one or more units of a

monocyclic heterocyclic compound having Si, Ge, Sn, P, Se, Te, Ti or Zr as a hetero atom and one to nine units, selected from a group derived from a monocyclic aromatic hydrocarbon and a monocyclic heterocyclic compound, bonded to each other.

5 8. The functional organic thin film as set forth in claim 7, wherein each of the units constituting the π -electron conjugated system of the π -electron conjugated system molecule is benzene, thiophene or ethylene.

9. The functional organic thin film as set forth in any one of
10 claims 1 to 8, wherein the functional organic thin film is 1 to 70 nm in total film thickness.

10. The functional organic thin film as set forth in any one of claims 1 to 9, wherein the functional organic thin film has molecular crystallinity.

15 11. A method for preparing a functional organic thin film, comprising:

a first step of forming a molecular thin film on a surface of a base, the molecular thin film having first functional groups periodically sticking out therefrom; and

20 a second step of allowing second functional groups of organic compounds to react with the first functional groups of the molecular thin film or third functional groups formed by converting the first functional groups so that an organic thin film in which the organic compounds are bonded and periodically arranged is formed on the
25 molecular thin film.

12. The method as set forth in claim 11, wherein a forming material of the molecular thin film used in the first step is silane compounds having the first functional groups, and

in the first step, the molecular thin film is formed by bonding a

network structure film moiety to the surface of the base and periodically sticking out the first functional groups from the network structure film moiety, the network structure film moiety being formed of silicon atoms and oxygen atoms as constituent atoms of the silane compounds.

5 13. A method for preparing a functional organic thin film, comprising:

a first step of bonding insulating molecules to a base via a network structure moiety formed of silicon atoms and oxygen atoms, the insulating molecules having first functional groups at the terminals,
10 and

a second step of allowing second functional groups located at the terminals of π -electron conjugated system molecules to react with the first functional groups of the insulating molecules or third functional groups formed by converting the first functional groups so
15 that the π -electron conjugated system molecules is bonded to the insulating molecules.

14. The method as set forth in any one of claims 11 to 13, further comprising, between the first step and the second step, a middle step of converting the first functional groups of the molecular thin film to the
20 third functional groups which can react with the second functional groups of the organic compounds.

15. The method as set forth in any one of claims 11 to 14, wherein the organic compounds used in the second step are compounds having the second functional groups and main skeletons which are
25 constituted of π -electron conjugated system molecules.

16. The method as set forth in claim 15, wherein each of the organic compounds has 30 or less units constituting the π -electron conjugated system contained in the π -electron conjugated system molecule, the units being linearly bonded to each other.

17. The method as set forth in claim 16, wherein each of the units constituting the π -electron conjugated system contained in the π -electron conjugated system molecule is one or more compounds selected from the group consisting of an aromatic hydrocarbon, a condensed polycyclic hydrocarbon, a monocyclic heterocyclic, a condensed heterocyclic, an alkene, an alkadiene and an alkatriene.
18. The method as set forth in any one of claim 15 to 17, wherein each of the units constituting the π -electron conjugated system contained in the π -electron conjugated system molecule has an acene skeleton with 2 to 12 benzene rings.
19. The method as set forth in any one of claim 15 to 17, wherein each of the units constituting the π -electron conjugated system contained in the π -electron conjugated system molecule is a π -electron conjugated system organic residue including at least one or more units of a monocyclic heterocyclic compound having Si, Ge, Sn, P, Se, Te, Ti or Zr as a hetero atom and one to nine units, selected from a group derived from a monocyclic aromatic hydrocarbon and a monocyclic heterocyclic compound, bonded to each other.
20. The method as set forth in claim 19, wherein each of the units constituting the π -electron conjugated system contained in the π -electron conjugated system molecule is benzene, thiophene or ethylene.
21. The method as set forth in any one of claims 14 to 20, wherein before the first step, a surface of the base is hydrophilized,
- in the first step, the hydrophilized base is immersed in a solution prepared by dissolving vinyltrihalogenosilane in a non-aqueous solvent so that the molecular thin film is formed in which the network structure film moiety is bonded to the surface of the base and vinyl

groups are periodically extending from a surface of the network structure film moiety,

before the second step, the resulting molecular thin film is oxidized and the vinyl groups are converted to carboxyl groups,

5 in a third step, the resulting base, on which the molecular thin film having the carboxyl groups is formed, is immersed in a solution prepared by dissolving aminoterthiophene in a non-aqueous solvent so that the functional organic thin film having a terthiophene monomolecular film formed on the network structure film moiety is
10 obtained.

22. The method as set forth in claim 13,

 wherein before the first step, a surface of the base is hydrophilized,

 in the first step, the hydrophilized base is immersed in a
15 solution prepared by dissolving aminooctadecyl trihalogenosilane in a non-aqueous solvent so that the network structure moiety is bonded to the surface of the base and the insulating molecules containing octadecane having an amino group at the terminal are periodically arranged on a surface of the network structure moiety,

20 in the second step, the base on which the insulating molecules having the amino groups are bonded thereto is immersed in a solution prepared by dissolving 1-carboxyl terthiophene in a non-aqueous solvent so that the π -electron conjugated system molecules containing terthiophene are bonded to the insulating
25 molecules.

23. An organic thin film transistor, comprising:

 a functional organic thin film formed on a surface of a substrate directly or indirectly;

 a gate electrode formed on the surface of the substrate

indirectly or directly;

source electrode and drain electrode formed on one surface of the functional organic thin film or on the other surface thereof; and

a gate insulating film formed between the gate electrode and
5 the source/drain electrodes,

wherein the functional organic thin film has π -electron conjugated system molecules bonded to a network structure moiety via insulating molecules, the network structure moiety being formed of silicon atoms and oxygen atoms and formed on the base.

10 24. A manufacturing method of an organic thin film transistor, comprising:

a step (A) for forming a functional organic thin film on a surface of a substrate directly or indirectly;

a step (B) for forming a gate electrode on the surface of the
15 substrate indirectly or directly;

a step (C) for forming source electrode and drain electrode on one surface of the functional organic thin film or on the other surface thereof; and

a step (D) for forming a gate insulating film between the gate
20 electrode and the source/drain electrodes,

wherein the step (A) includes a first step of bonding insulating molecules, having first functional groups at the terminals, to the base via a network structure moiety formed of silicon atoms and oxygen atoms and a second step of reacting second functional groups located at
25 the terminals of π -electron conjugated system molecules to the first functional groups of the insulating molecules or third functional groups formed by converting the first functional groups so that the π -electron conjugated system molecules are bonded to the insulating molecules.